

# **Reconstructing Historic Insect Outbreaks from Tree-Rings**

**Ed Berg**

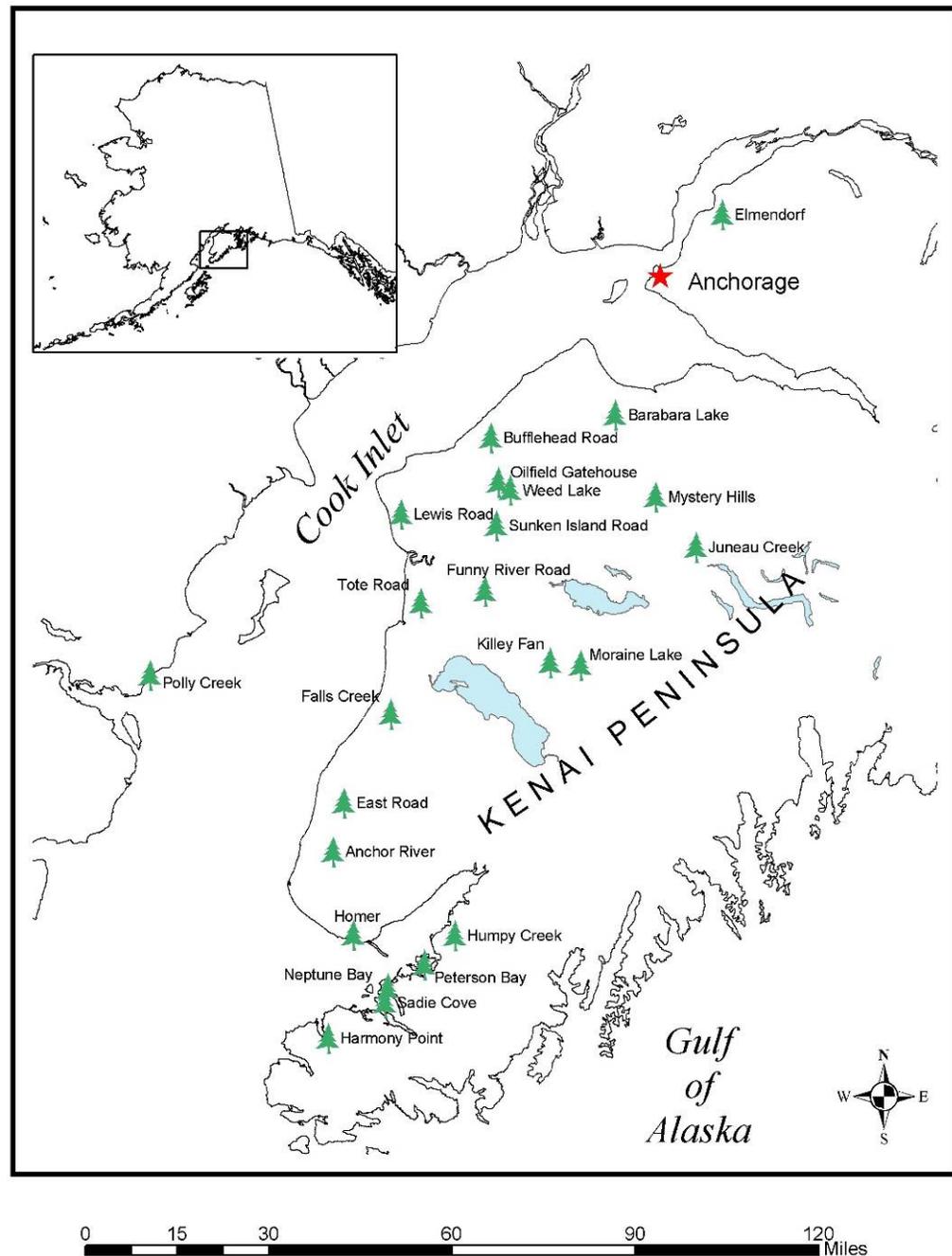
**US Fish and Wildlife Service  
Kenai National Wildlife Refuge  
Soldotna, Alaska**

**SWAN Meeting  
Homer, Alaska  
March 6, 2007**

# Topics of this Presentation

- **Using tree-rings to study bark beetle outbreak history**
- **Results from the Kenai and Yukon**
- **Current study in Lake Clark NPP**
- **Proposed study in Katmai NPP**

# Kenai Study Sites



# Yukon Territory

Kluane National Park

Study Area

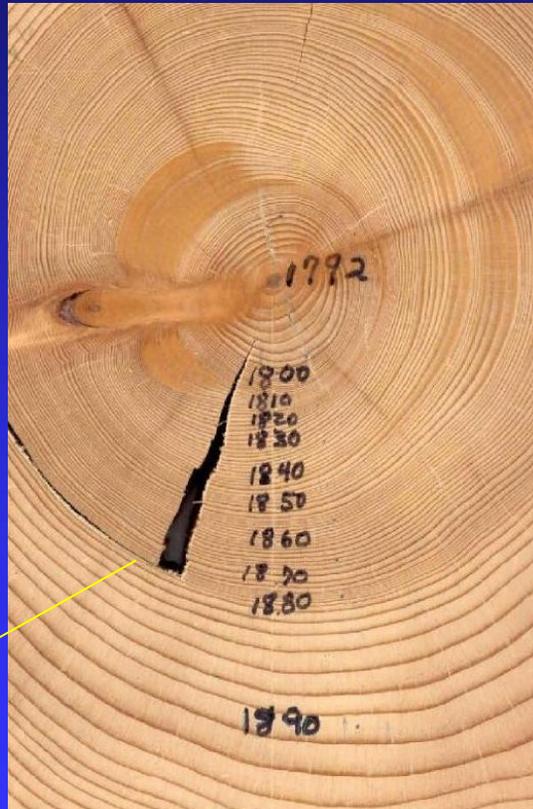


# Growth Releases in Tree-rings

- **Bark Beetles Kill the Larger Trees First.**

- **Smaller Trees are Released from Competition, and Grow Faster.**

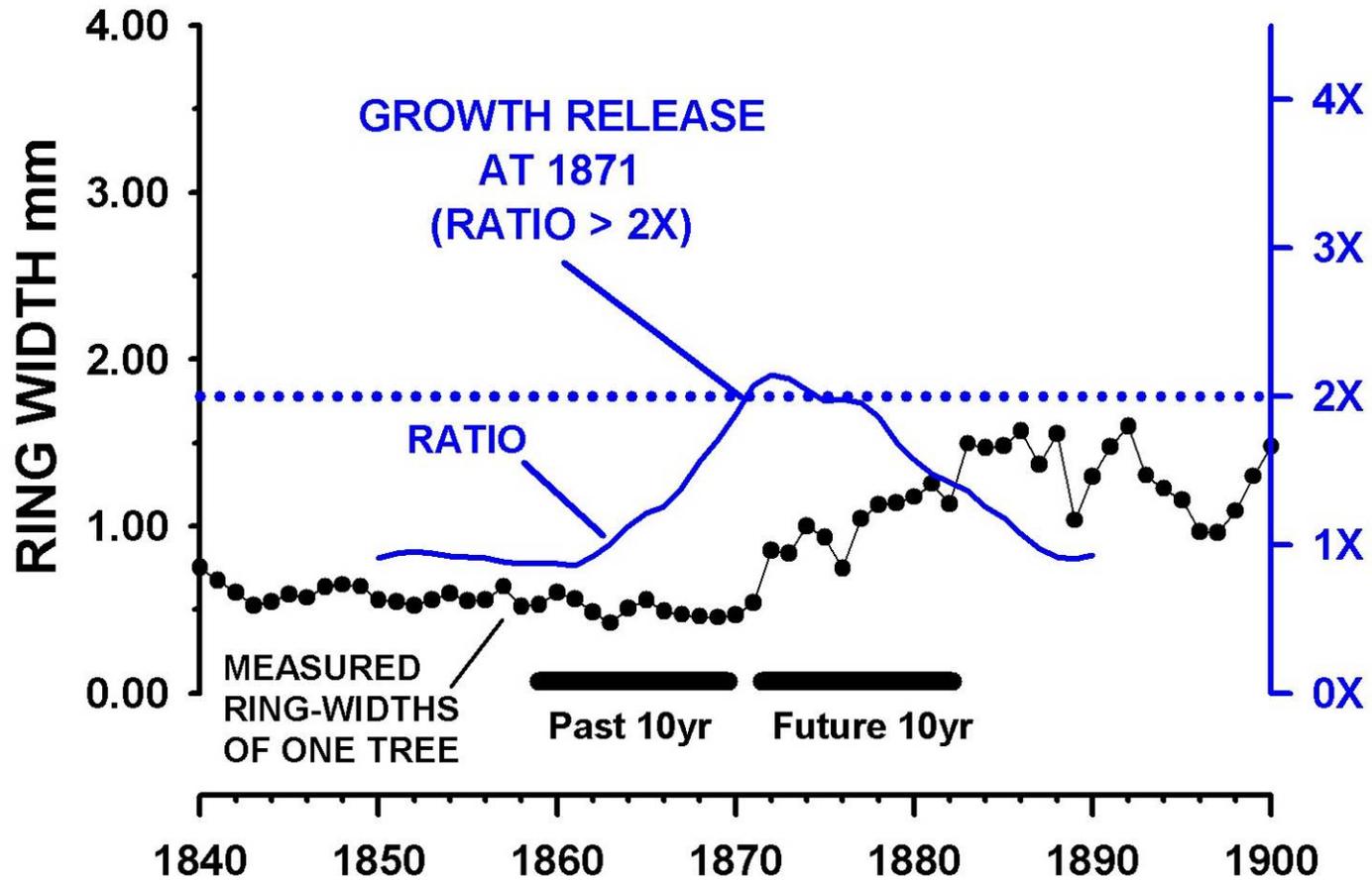
# An Extreme Example of a Growth Release



1884  
Release



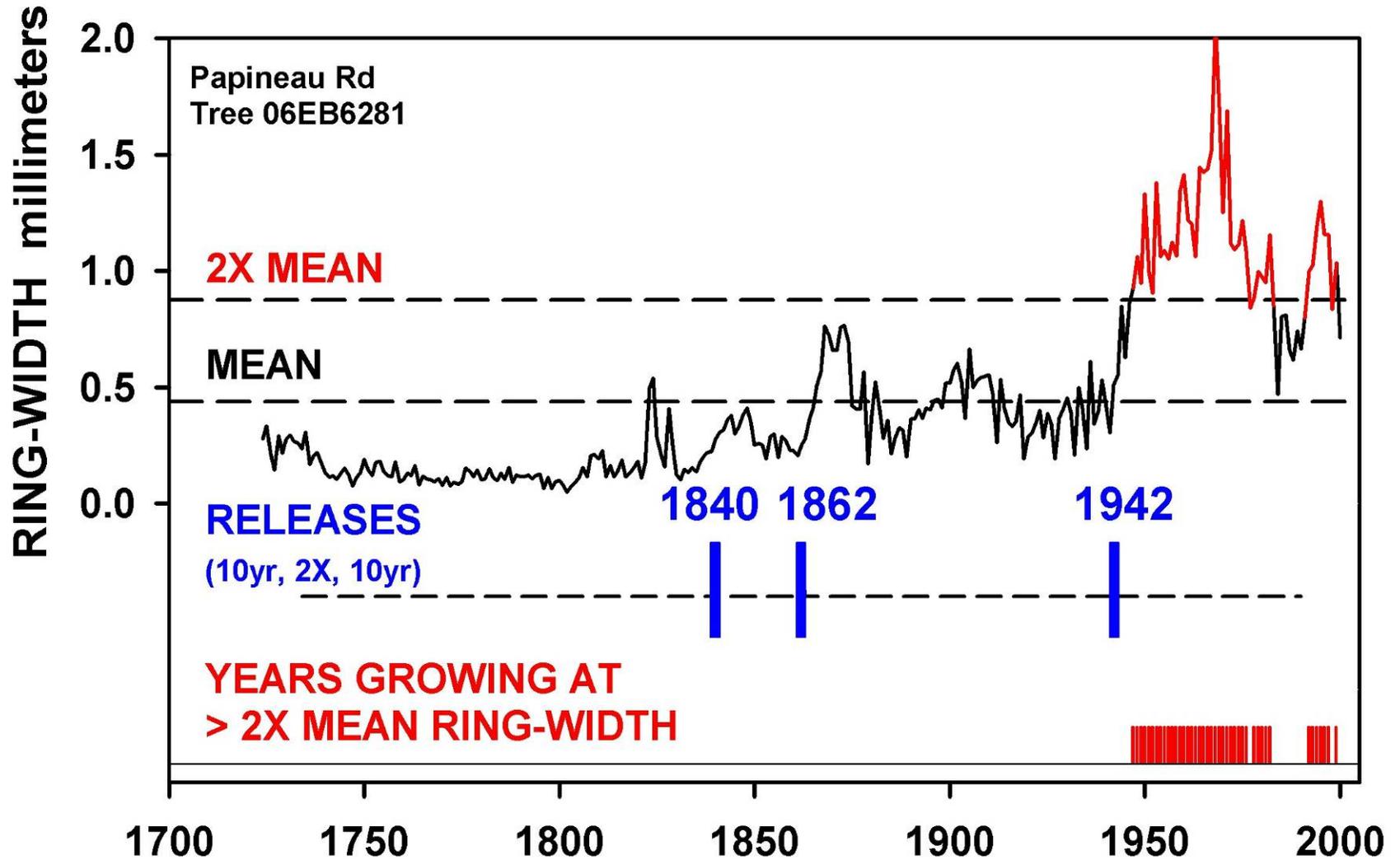
# DEFINITION OF A GROWTH RELEASE



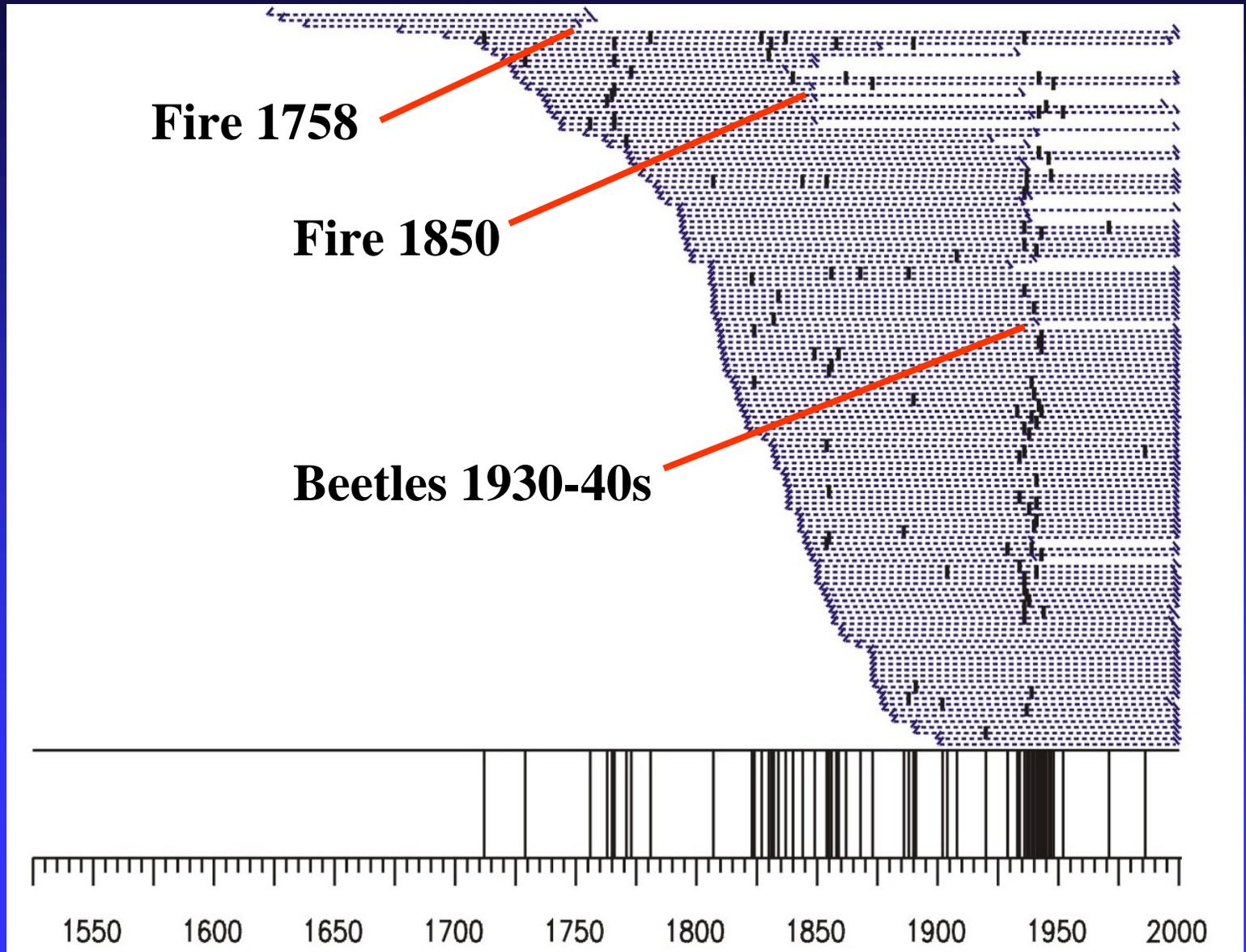
WE DEFINE A "GROWTH RELEASE" AS A DOUBLING OF THE RING-WIDTH OVER A TEN-YEAR PERIOD.

Ratio of future 10yr mean to past 10yr mean

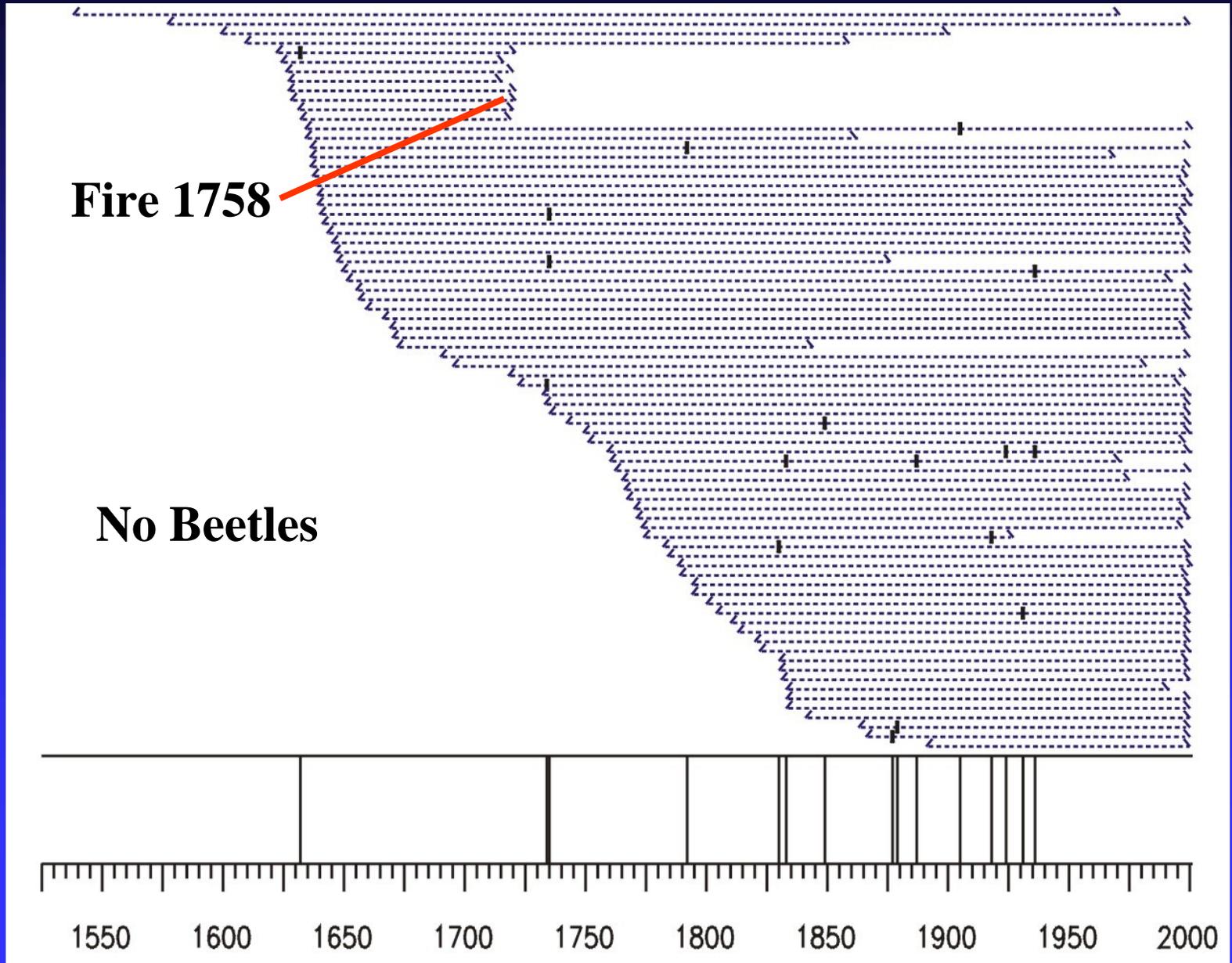
# RELEASE EXAMPLE



# Papineau Road

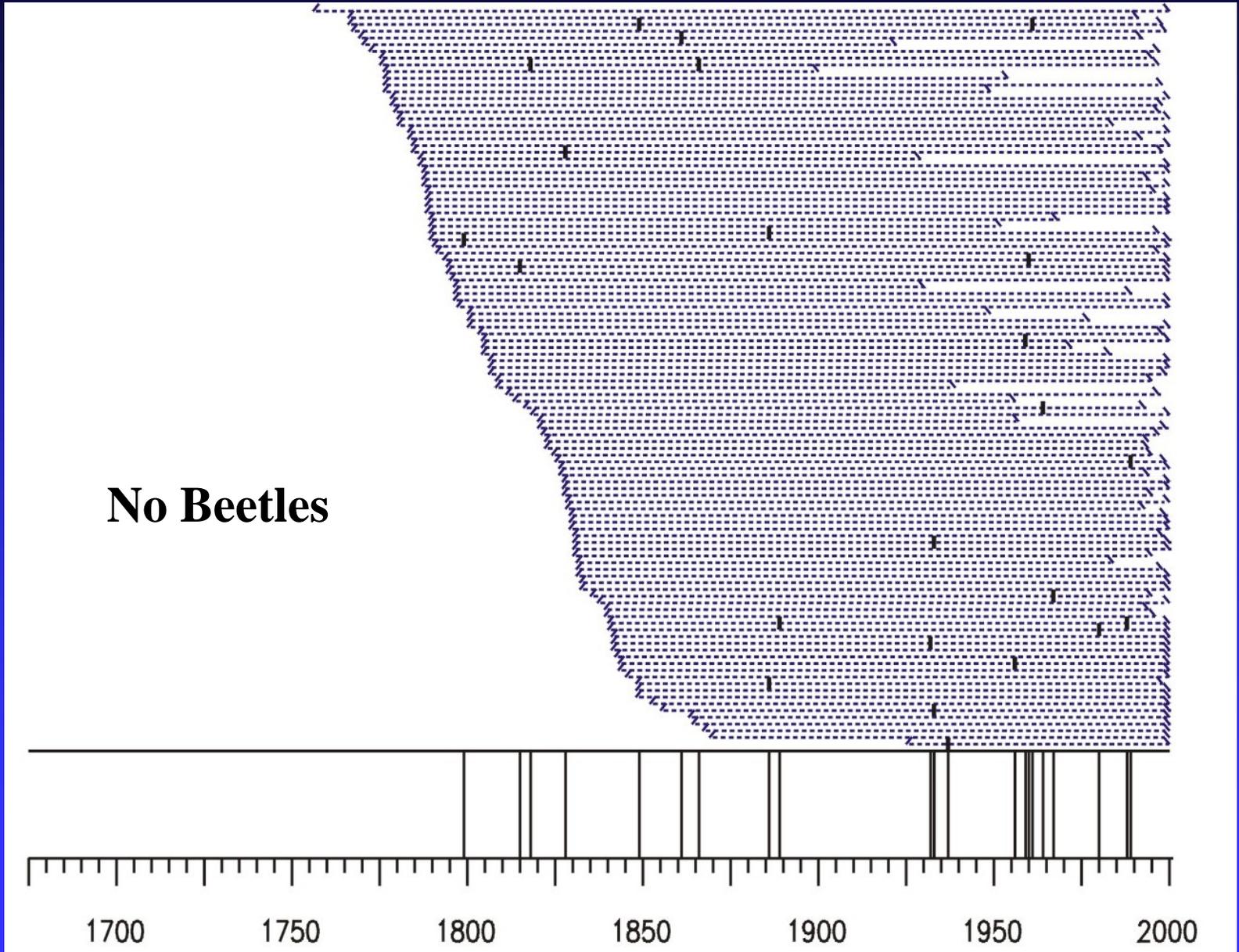


# Ten Km



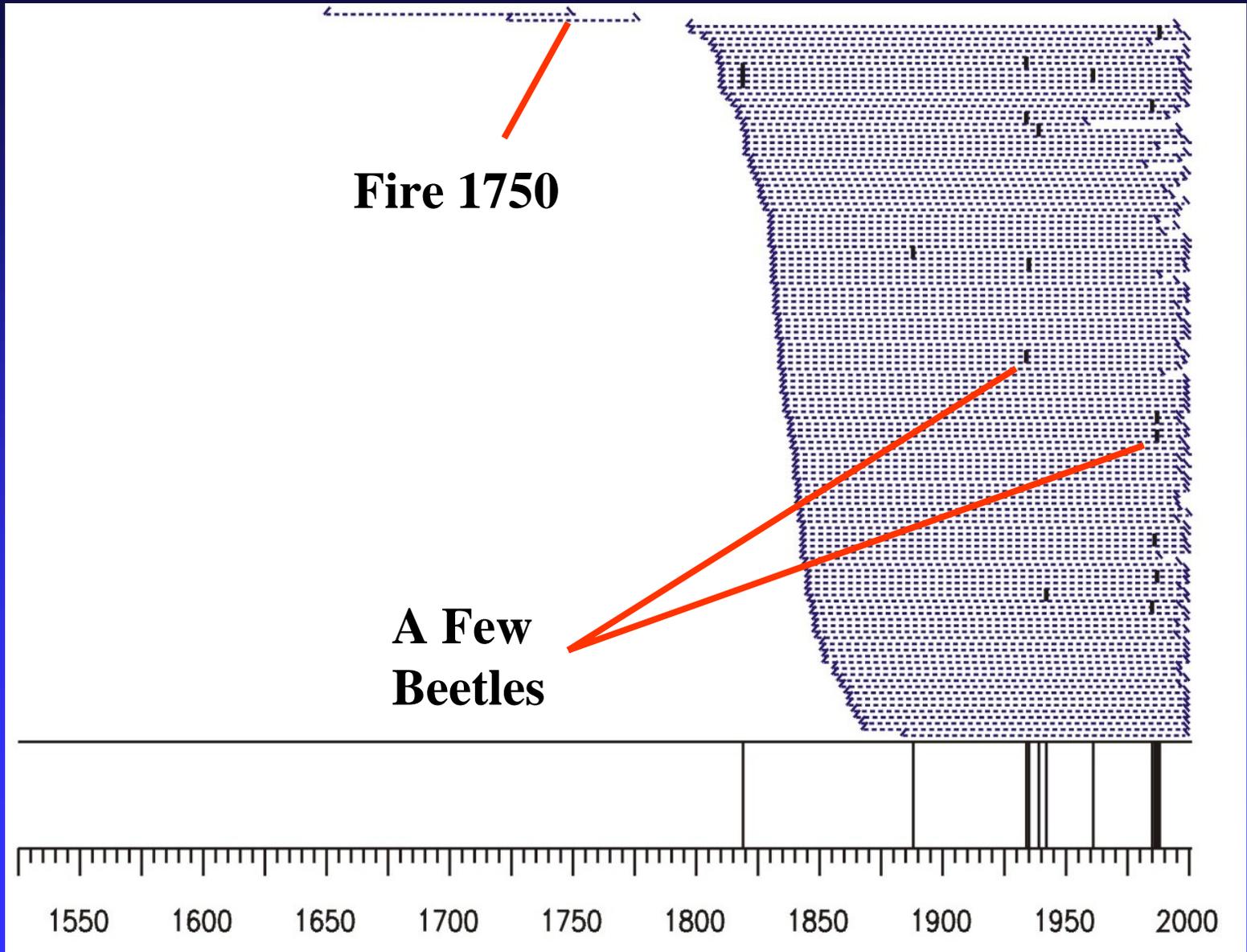
Kluane

# Airport Road



Kluane

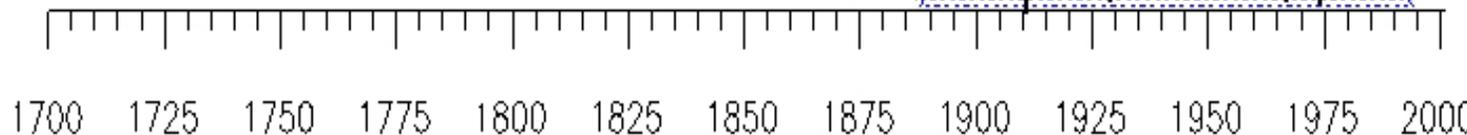
# Marshall Creek



# Bufflehead Road Release Pattern

**Statistically  
Significant  
Releases**

**Each horizontal line represents one tree.  
Black bars show growth releases.**

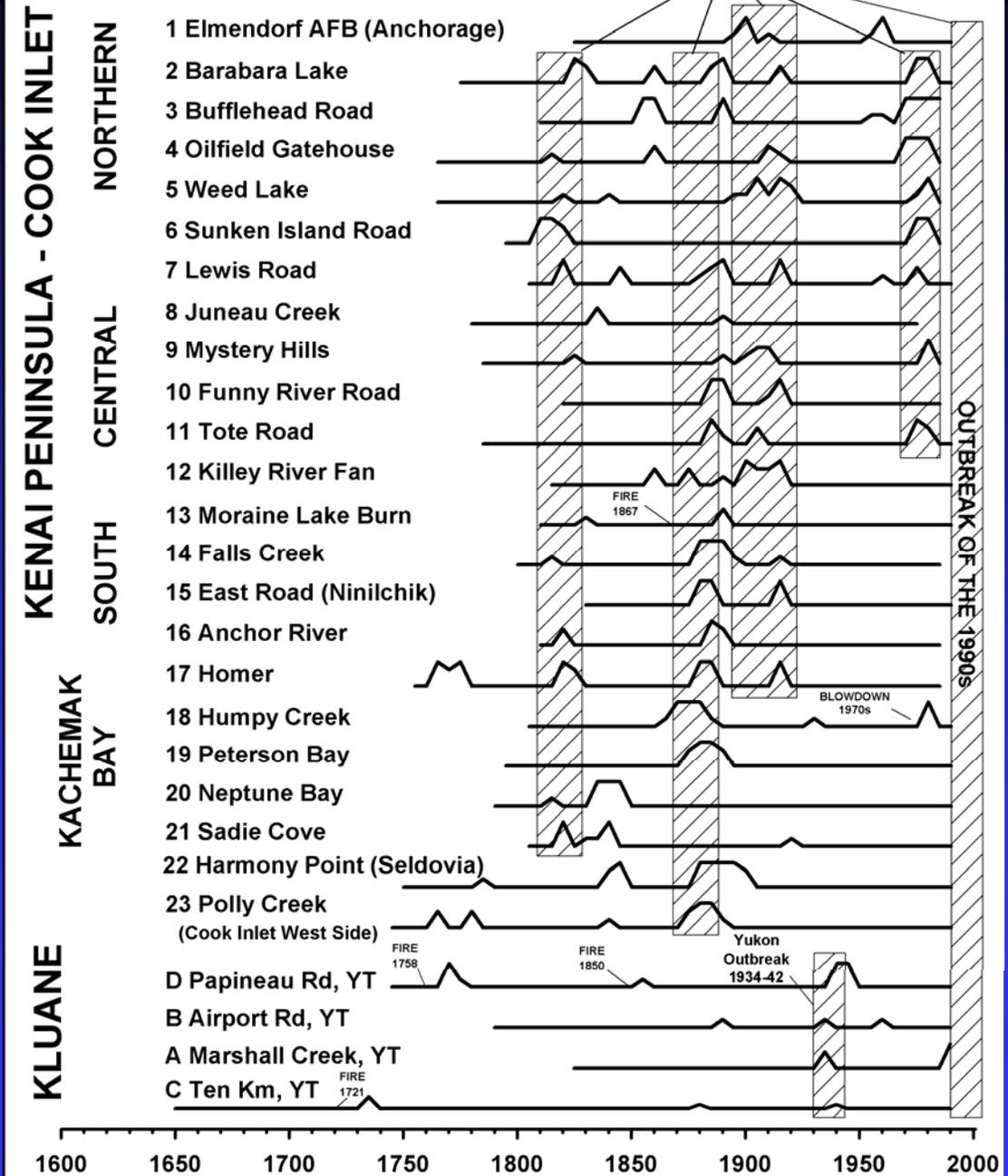


**Kenai  
Peninsula**

# Spruce Bark Beetle Outbreak Summary

## OUTBREAK HISTORY

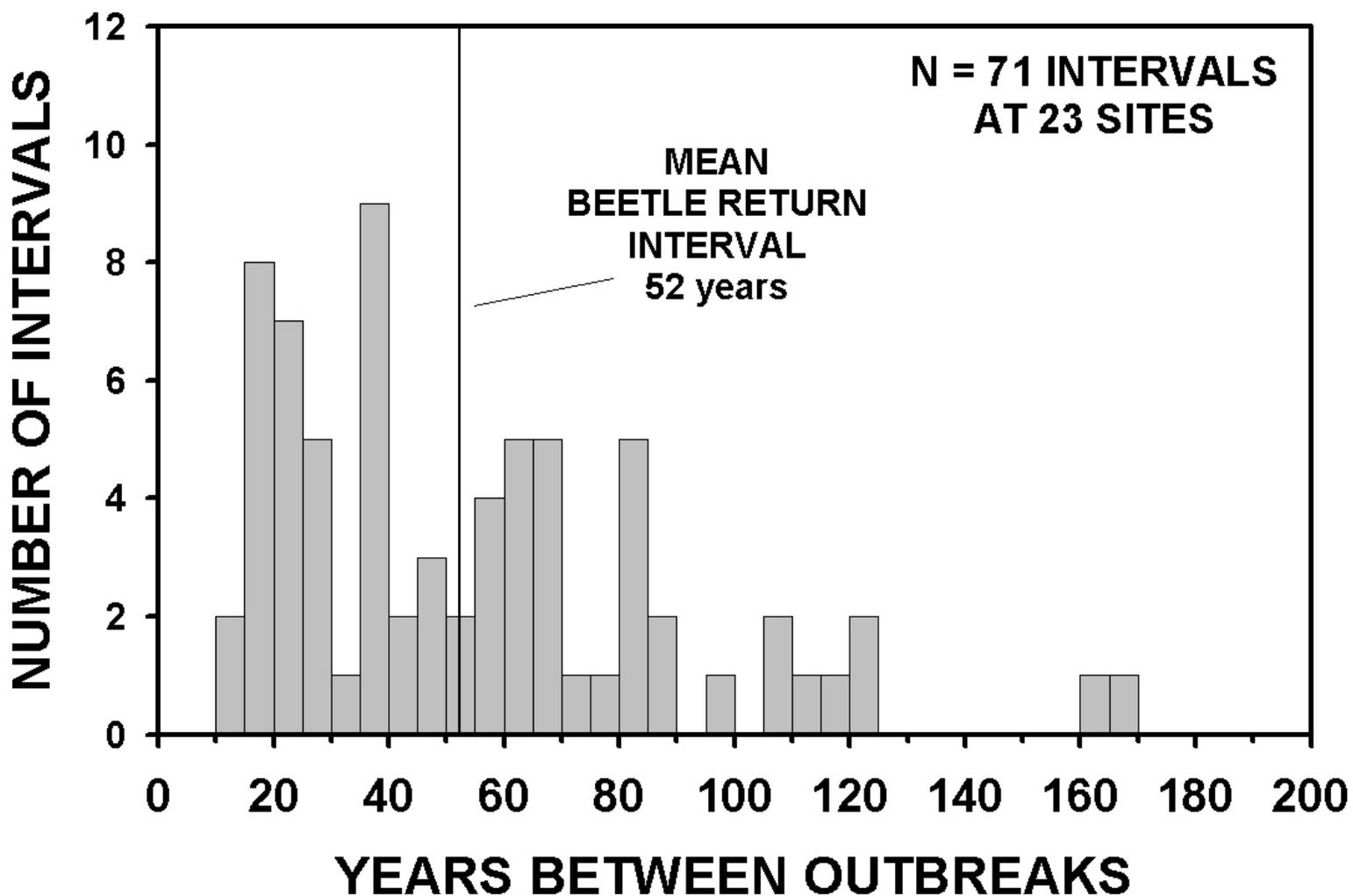
Regional Beetle Outbreaks



# Beetle-Return-Intervals

## SPRUCE BARK BEETLE OUTBREAKS

ESTIMATES BASED ON GROWTH RELEASES



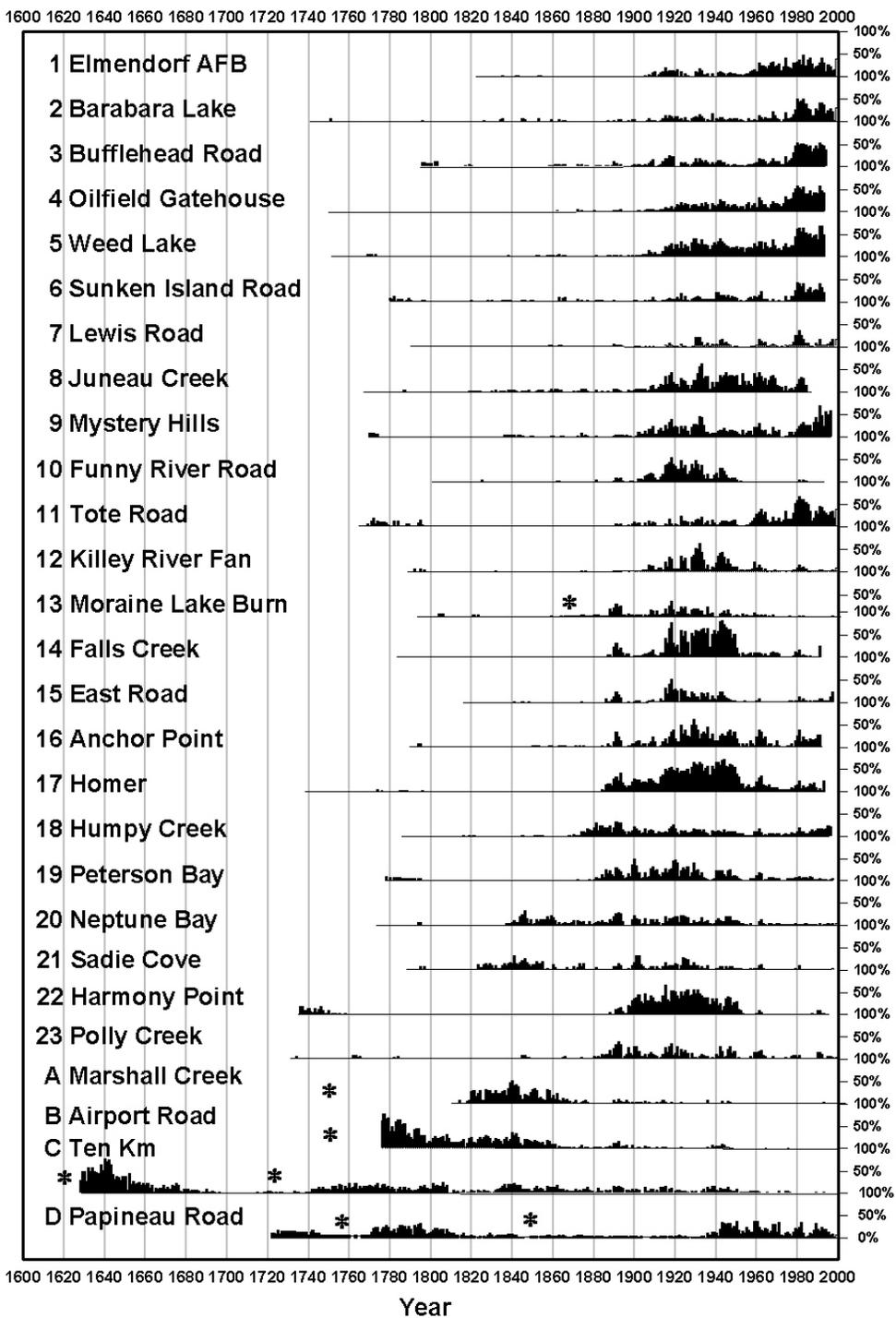
# Percentage of Trees With Ring-widths > 2X Mean

## Northern Kenai

## Southern Kenai

Cook Inlet  
West Side

## Kluane

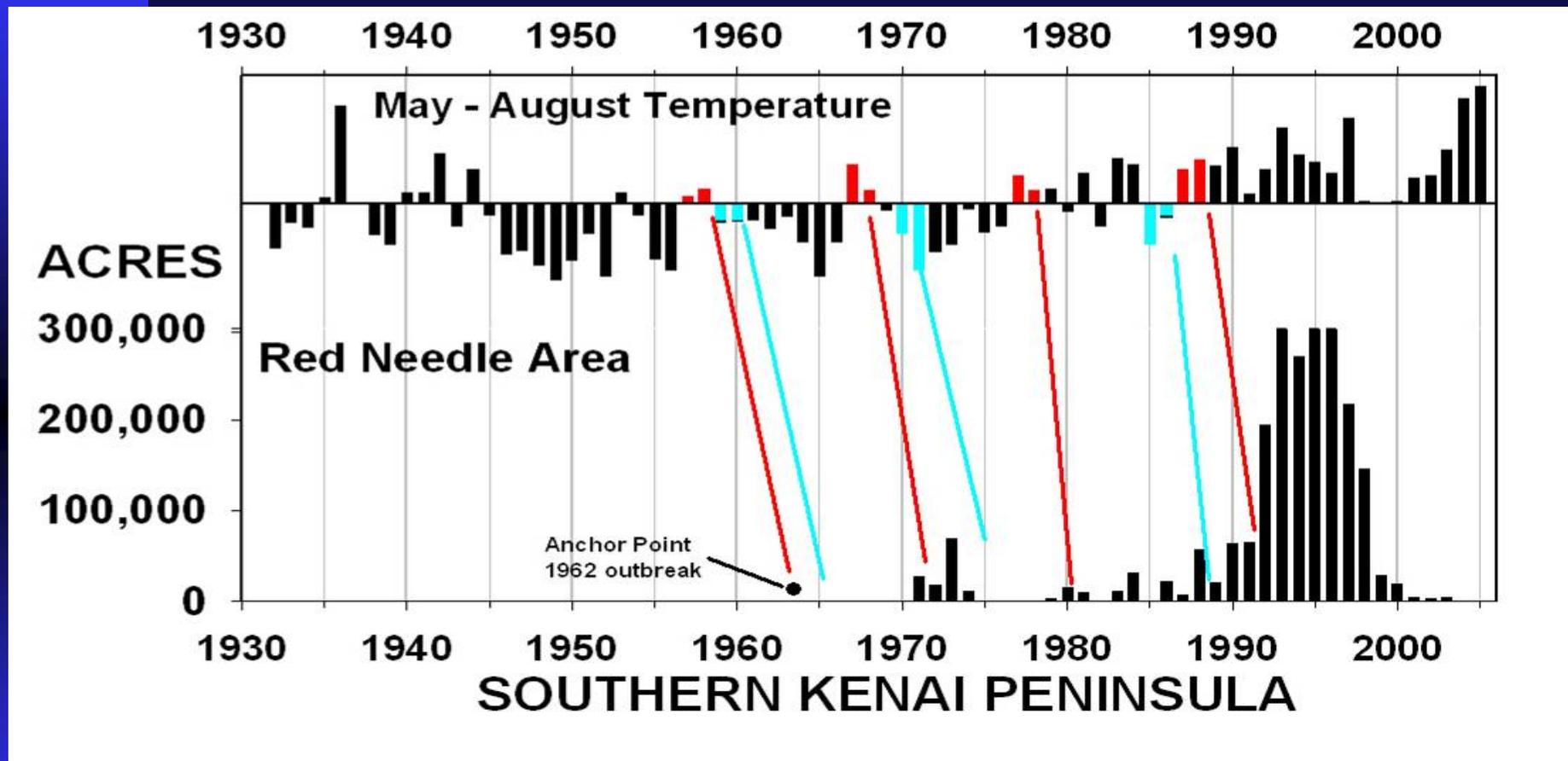


# **Bark Beetles and Runs of Warm Summers**

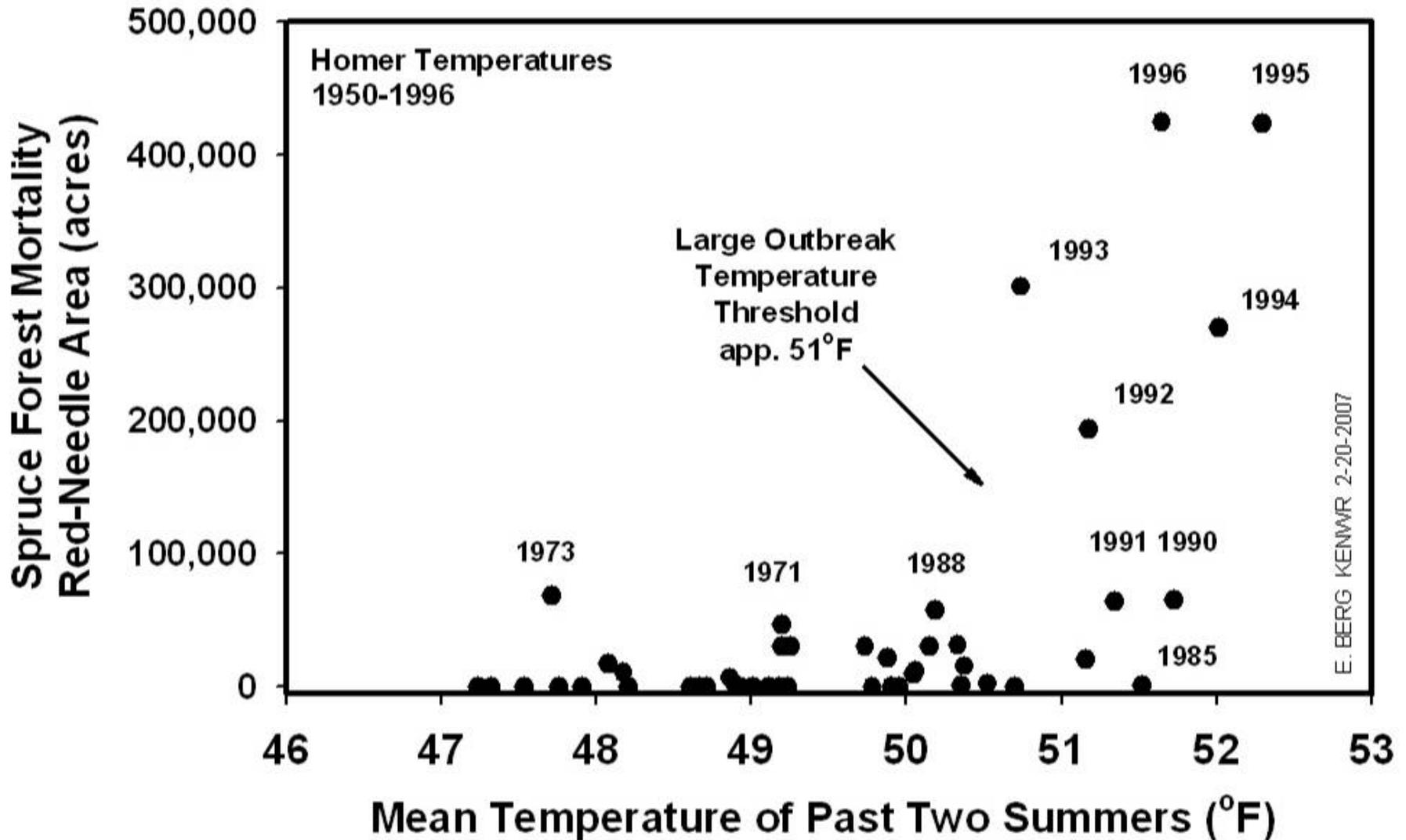
**Two factors are critical:**

- (1) A Loaded Gun – The forests must be mature or very mature**
- (2) A Trigger – a run of 2 or more warm summers can initiate an outbreak**

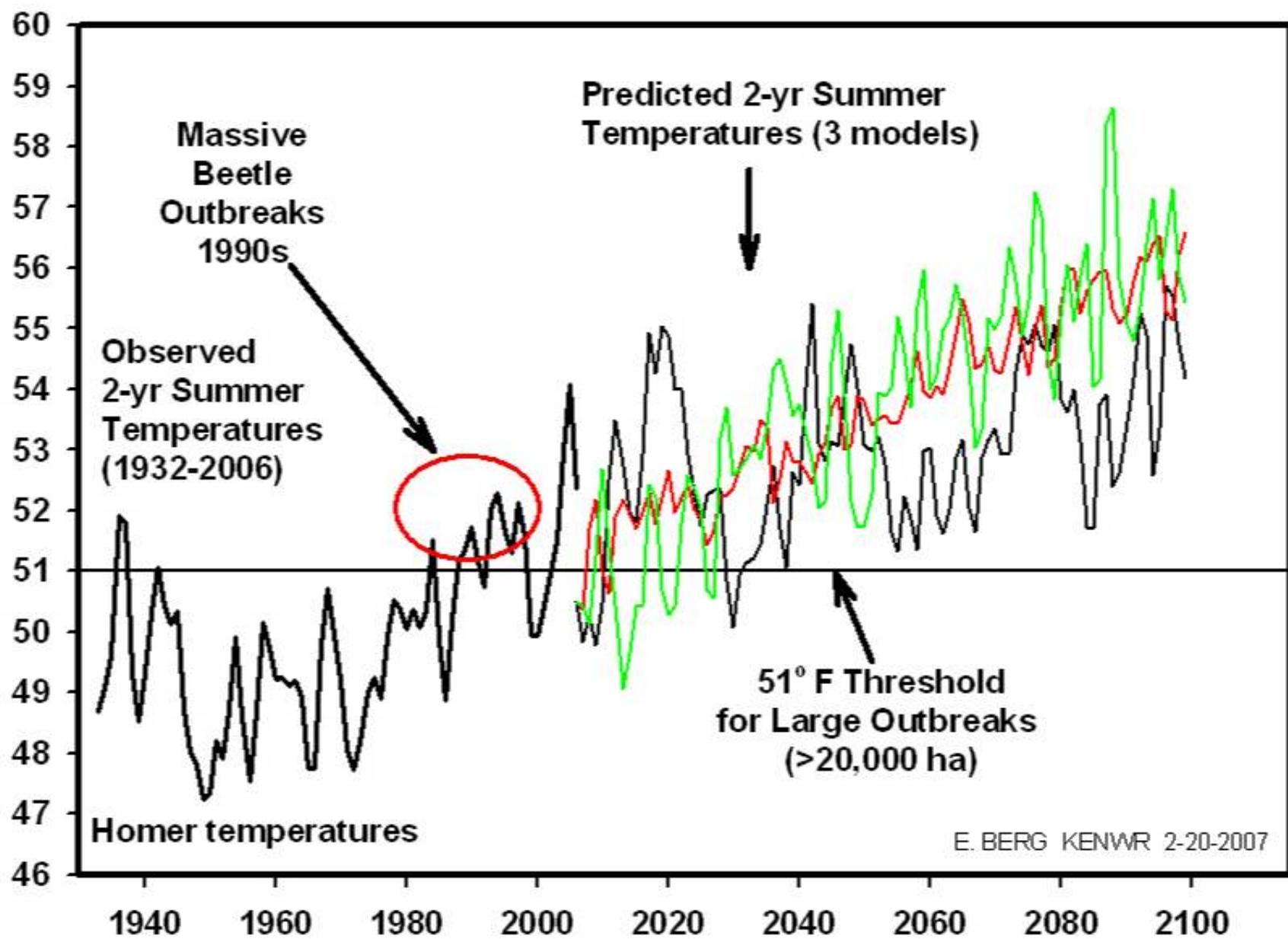
# Kenai Runs of Warm and Cool Summers



# Beetle Outbreak Threshold



Mean Temperature of Past Two Summers ( $^{\circ}\text{F}$ )



# Lake Clark and Katmai Studies

**Rosemary Sherriff**

**Amy Miller**

**Ed Berg**

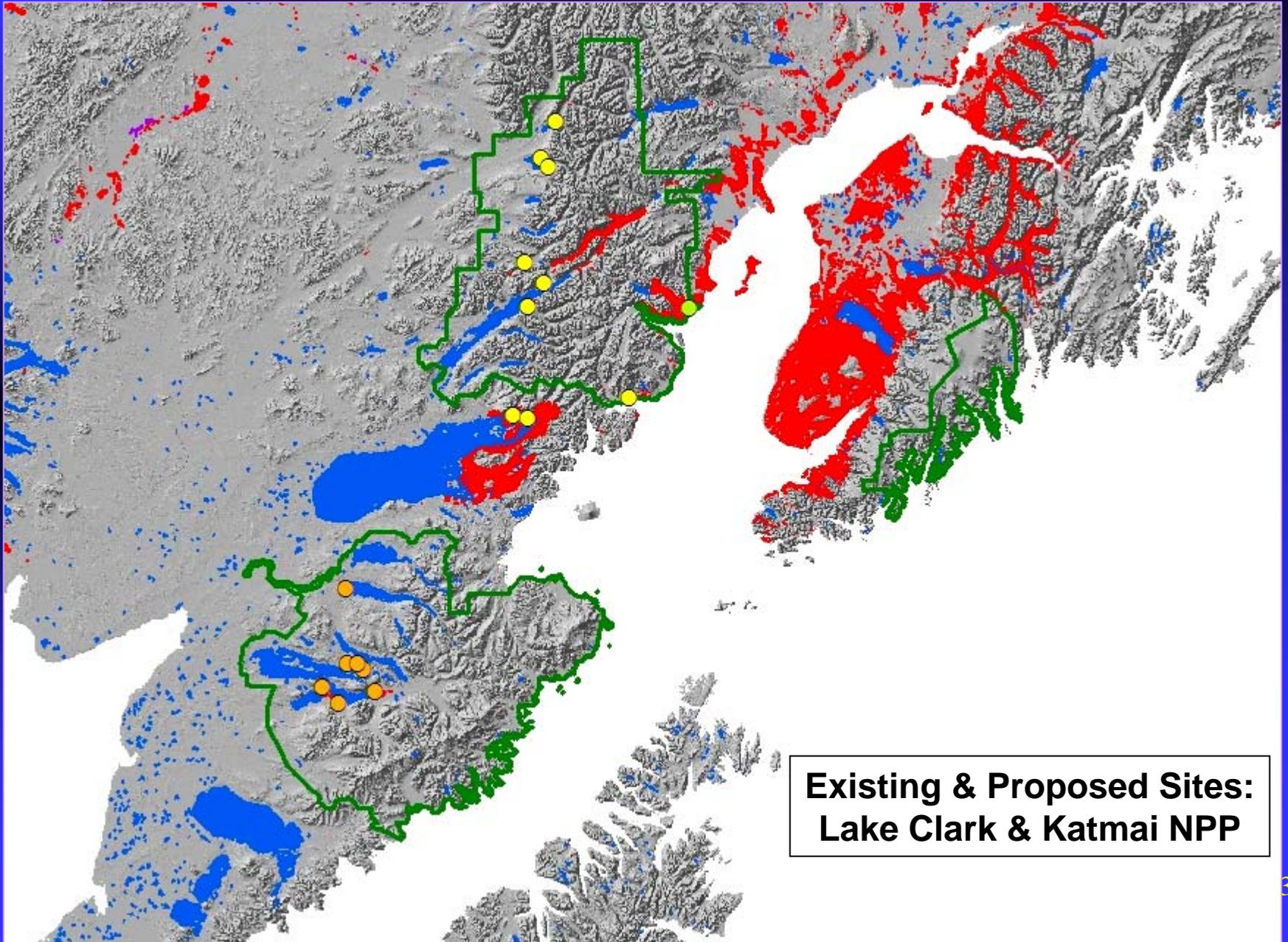
**2005**

**2007**

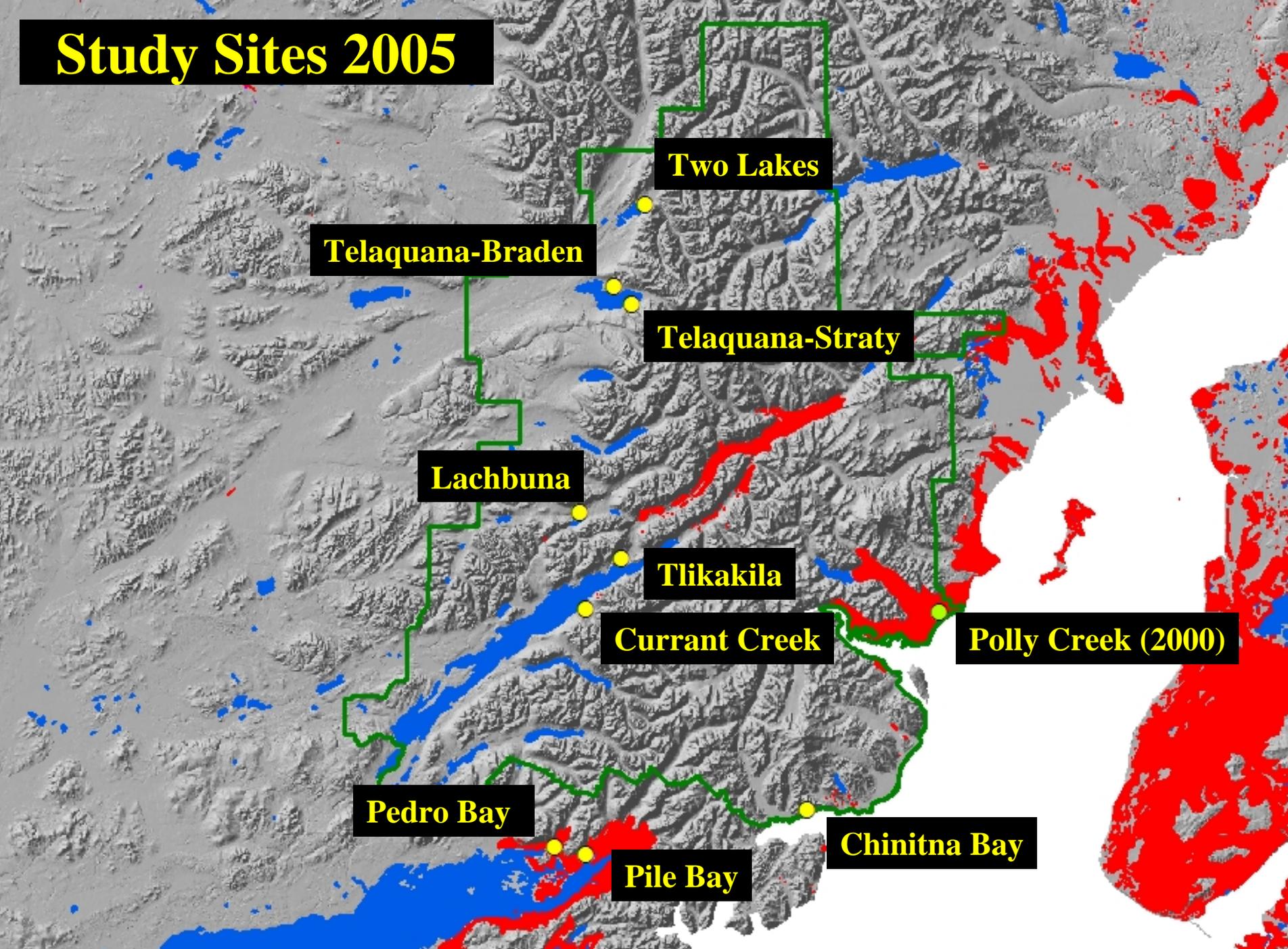
# Rosemary Sherriff



# Cook Inlet Beetle-Killed Spruce



# Study Sites 2005



# Polly Creek

- **A mature Sitka/Lutz forest with 95% beetle kill in 1990s**
- **Reported dead in 1899 by the Harriman Expedition**
- **Trees germinated under a closed canopy on nurse logs**
- **No evidence of fire in soil**
- **Median tree age at least 214 years**

# Nurse Wood



# Nurse Wood



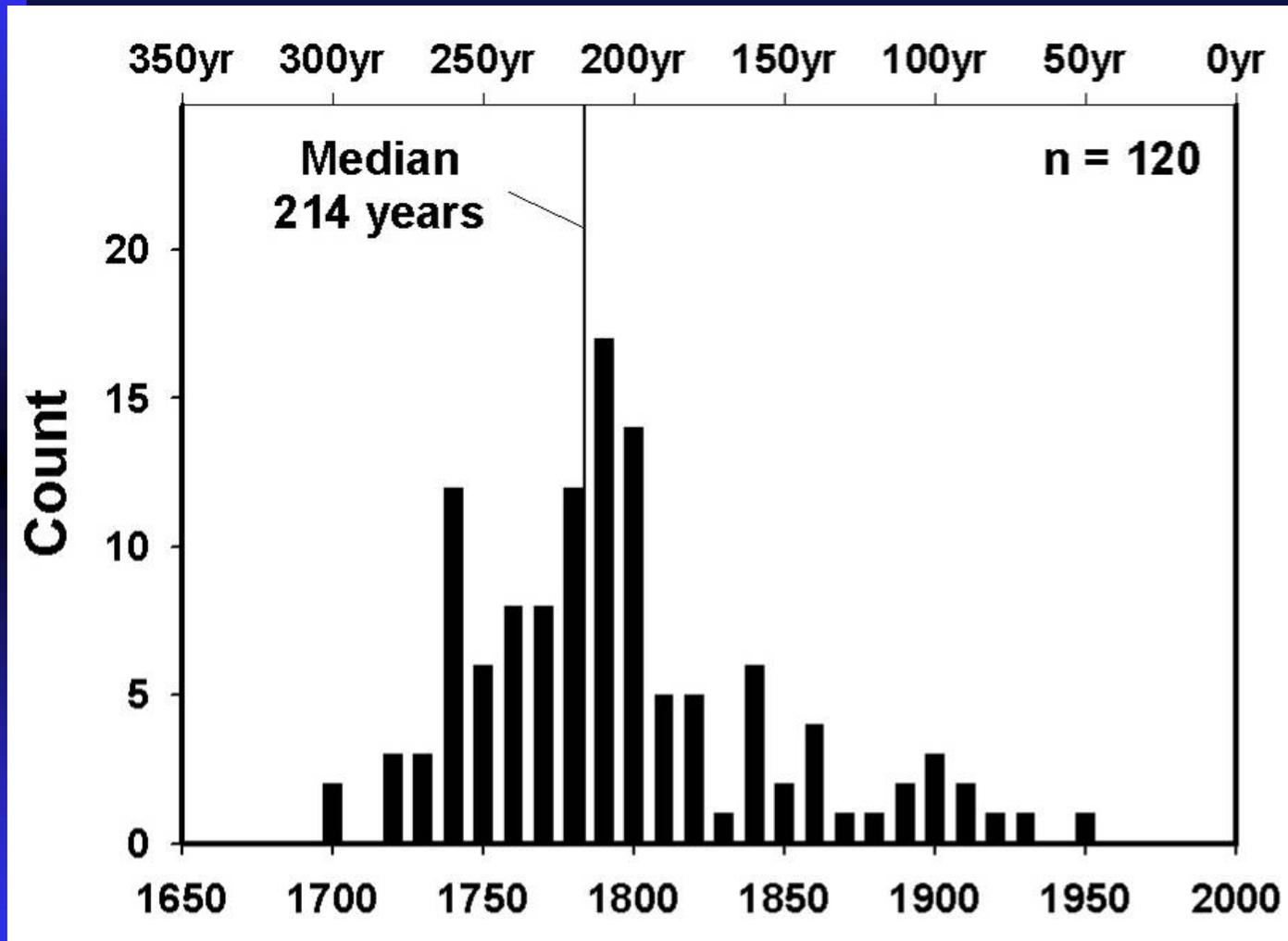
05.20.2004

# Trees Germinated on Nurse Wood



**Almost all of the trees at Polly Creek looked like this.** 28

# Polly Creek Tree Ages



Tree ages measured at coring height of ~1 m. Actual tree ages are probably 20-30 years older.

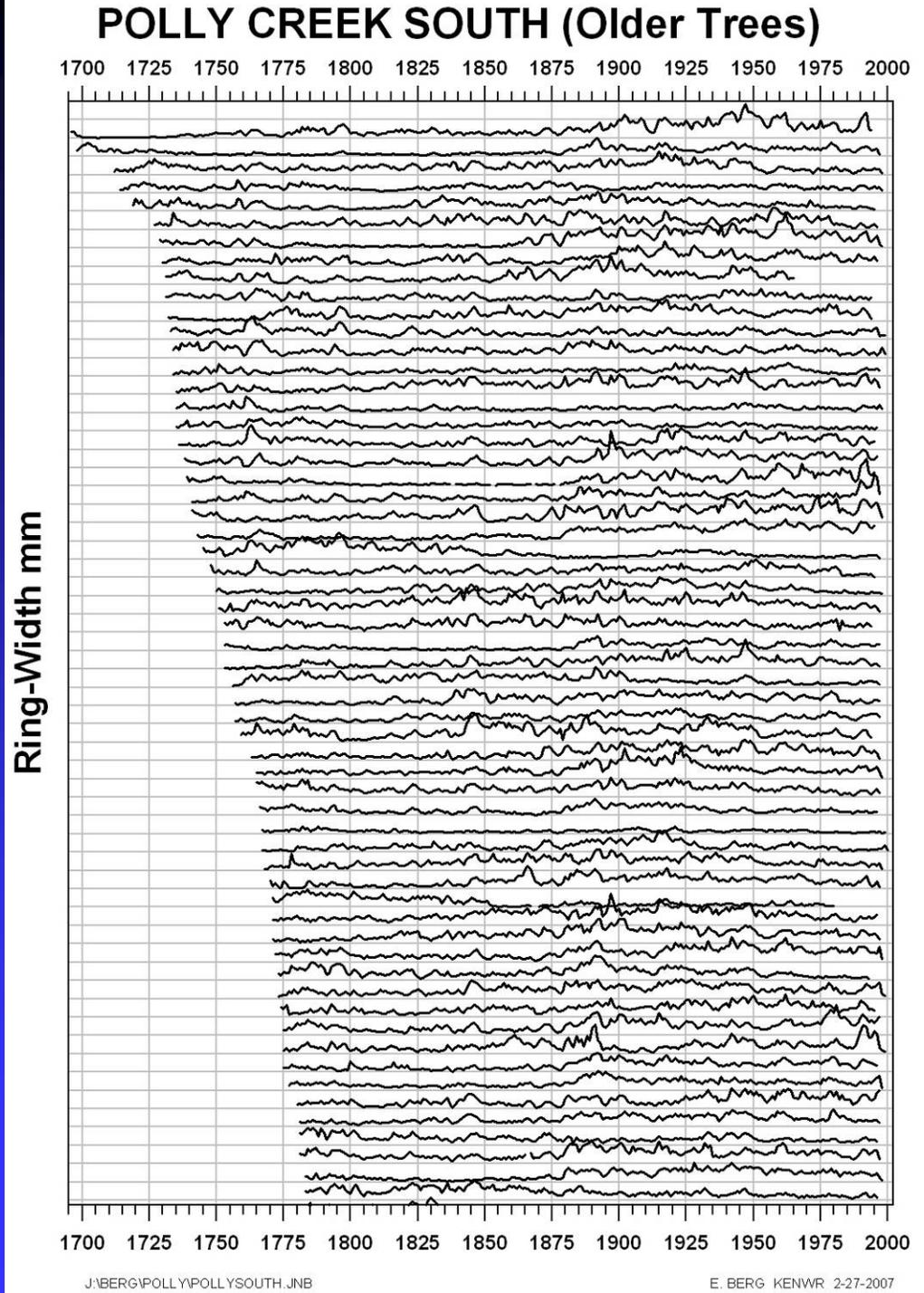
# The Raw Data

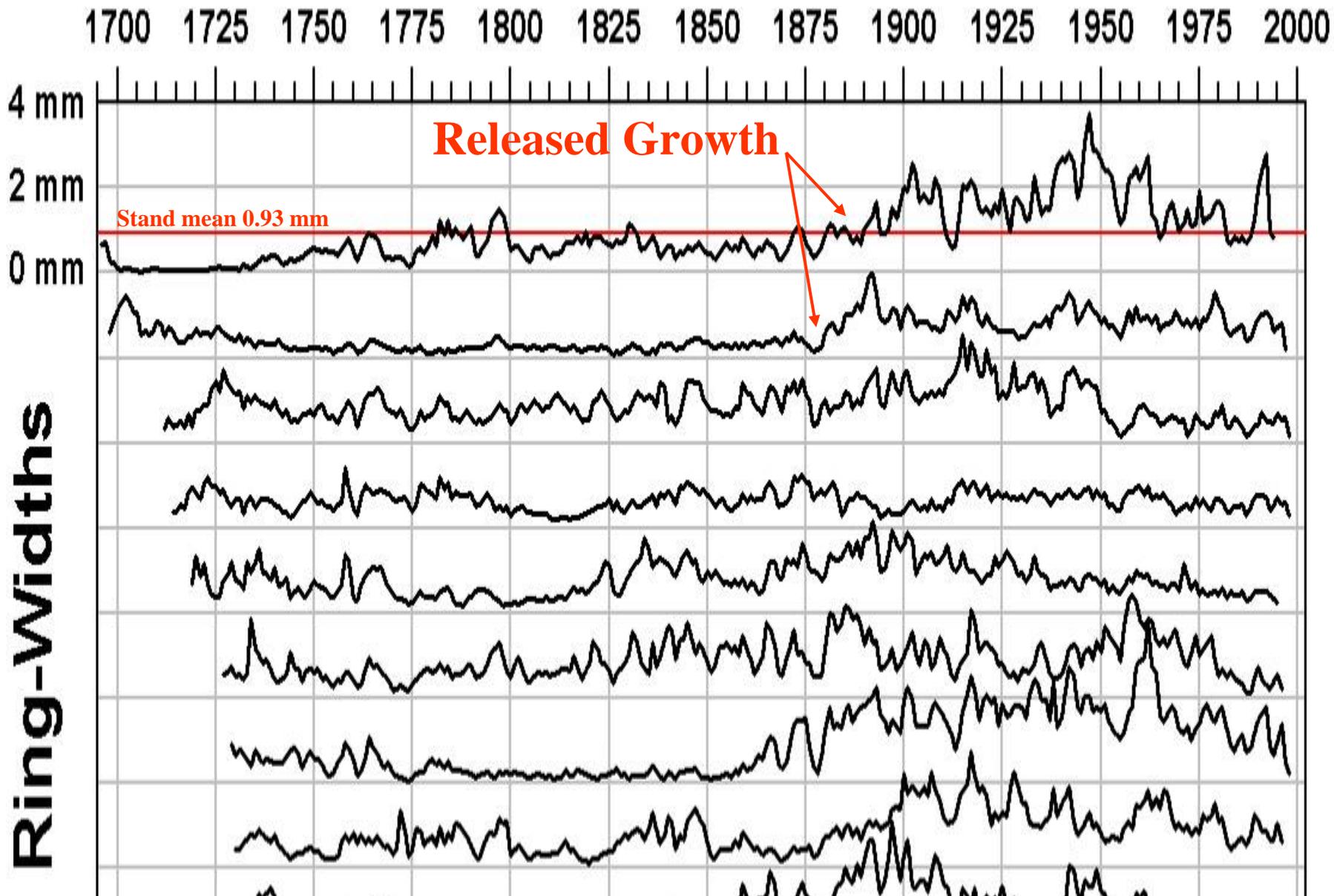
These are mature trees, born under a closed canopy.

Some show a distinct release after c.1875.

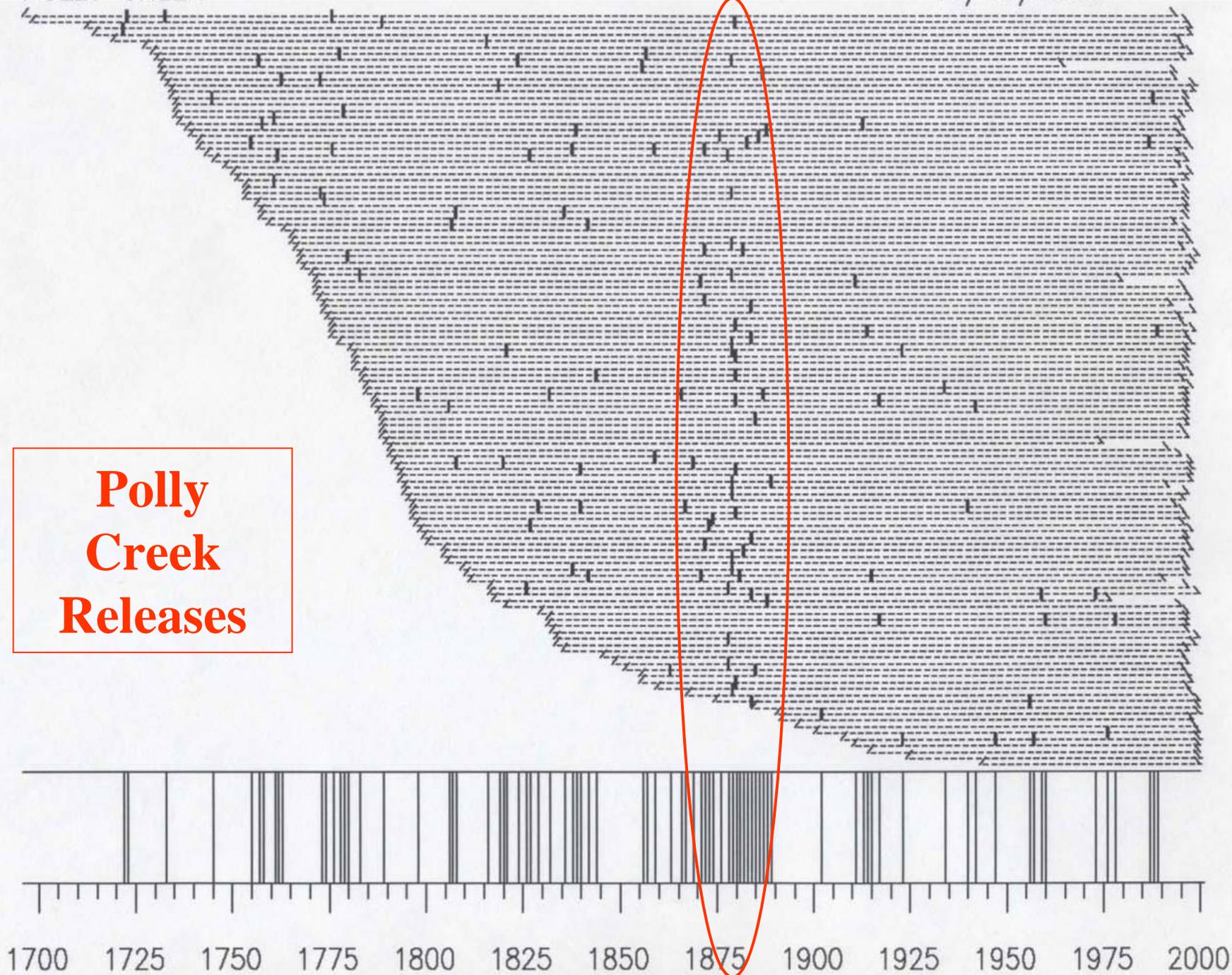
Average annual diameter growth is slow, very suppressed.

Mean ring-width = 0.93 mm/year. This translates to diameter growth of 3.7 inches/50 years.

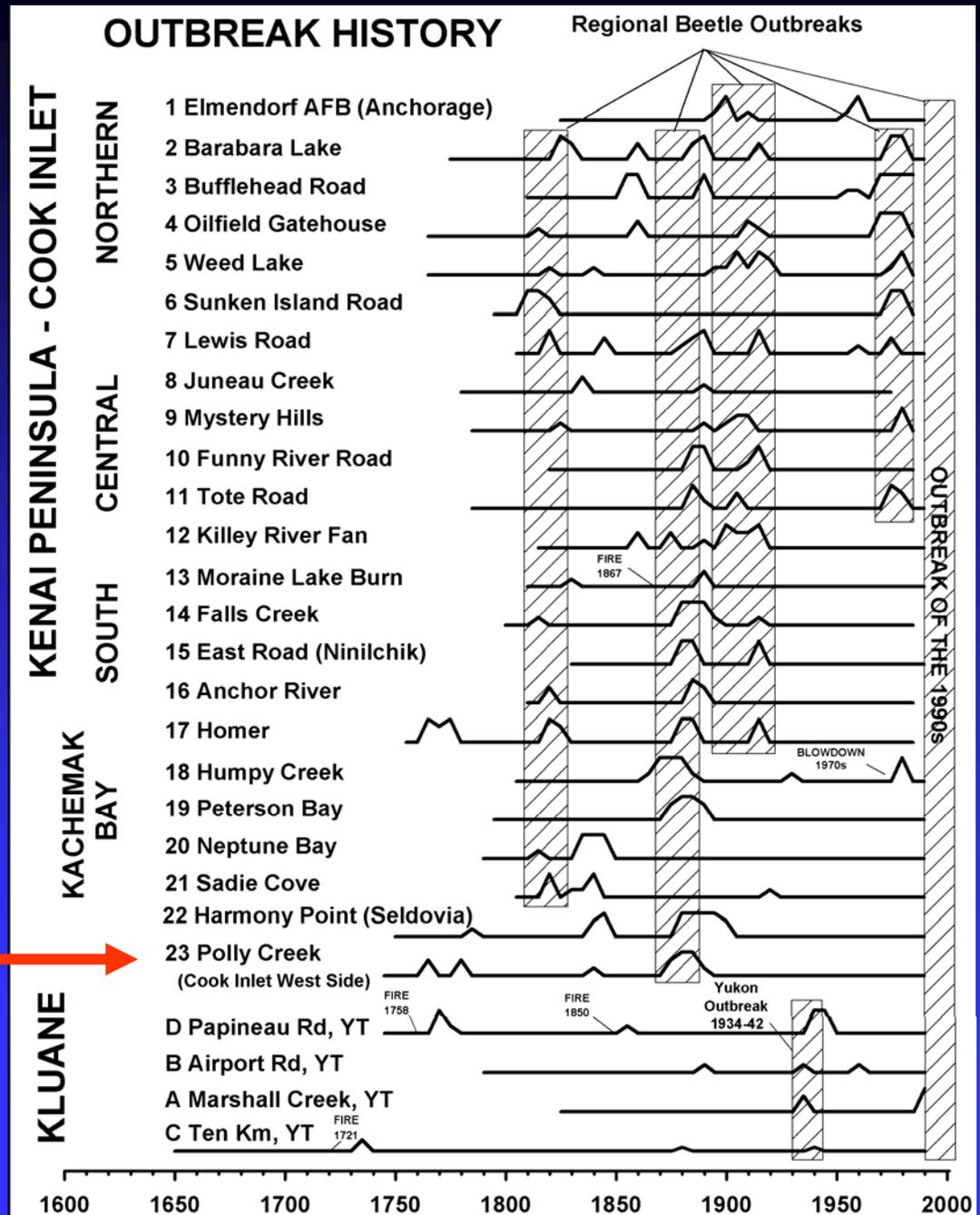




**Polly  
Creek  
Releases**



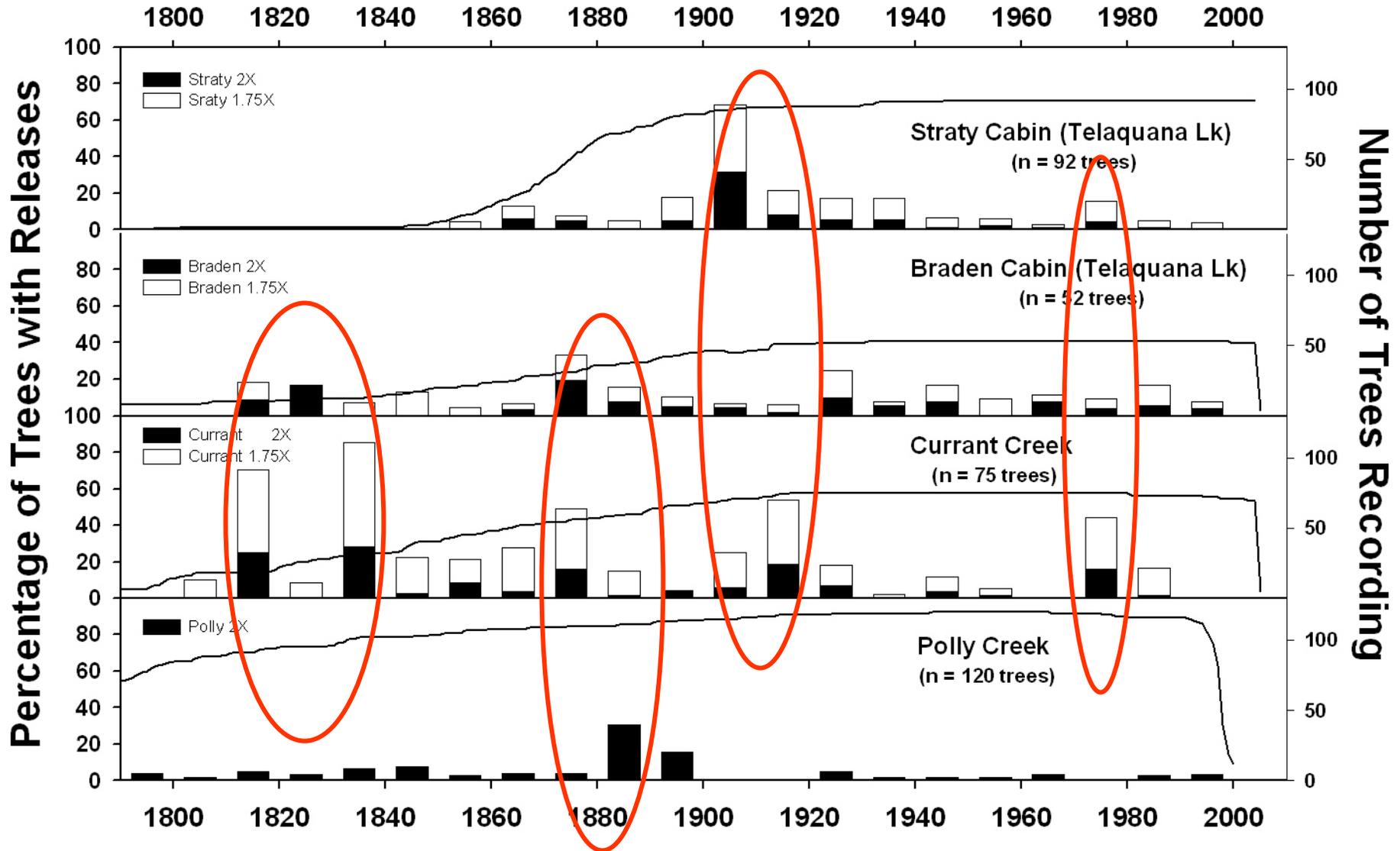
# Spruce Bark Beetle Outbreak Summary



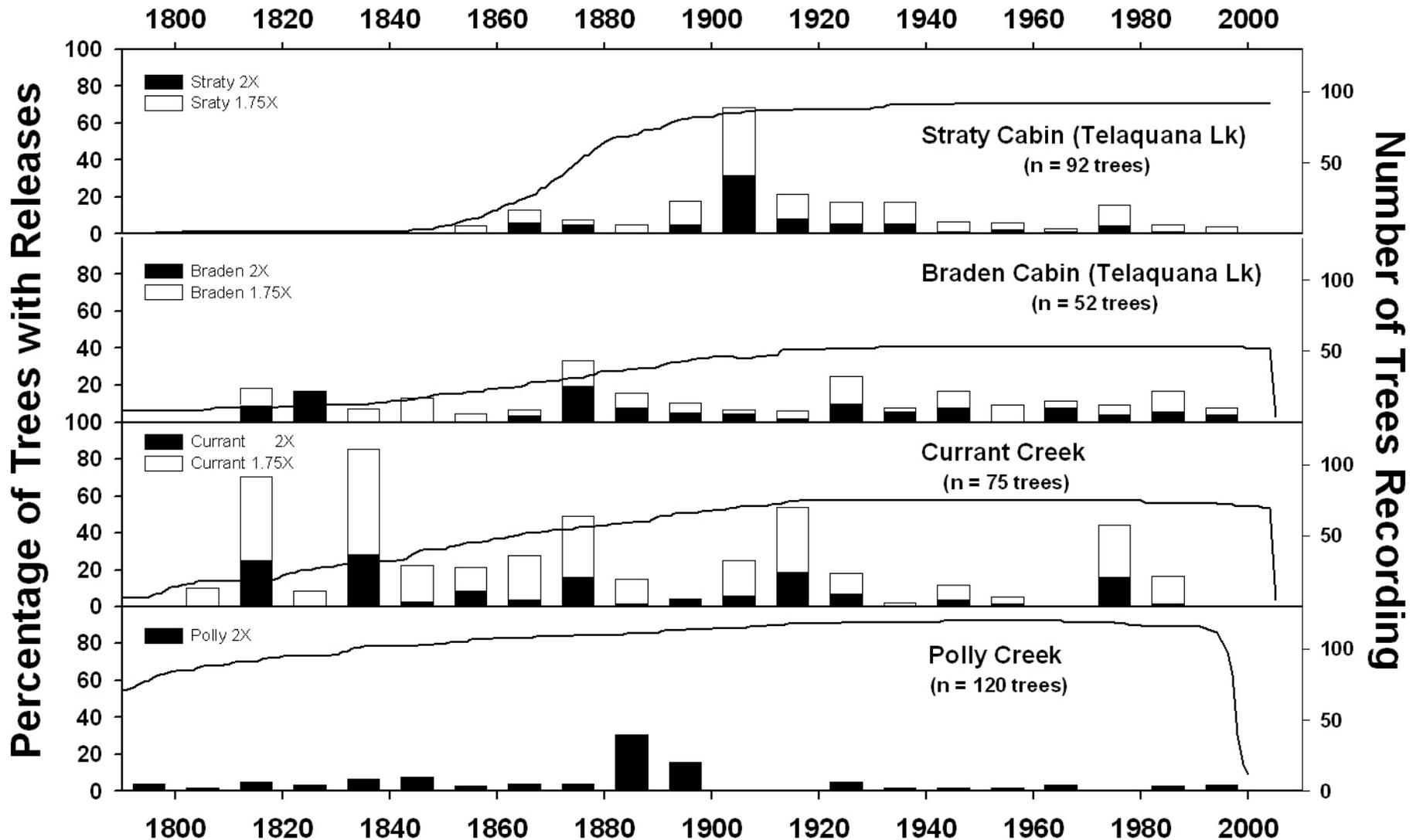




# Preliminary Lake Clark Data



# Preliminary Lake Clark Data



# Lake Clark NPP Study Sites 2005

Telaquana-Braden

Two Lakes

Telaquana-Straty

Lachbuna

Tlikakila

Currant Creek

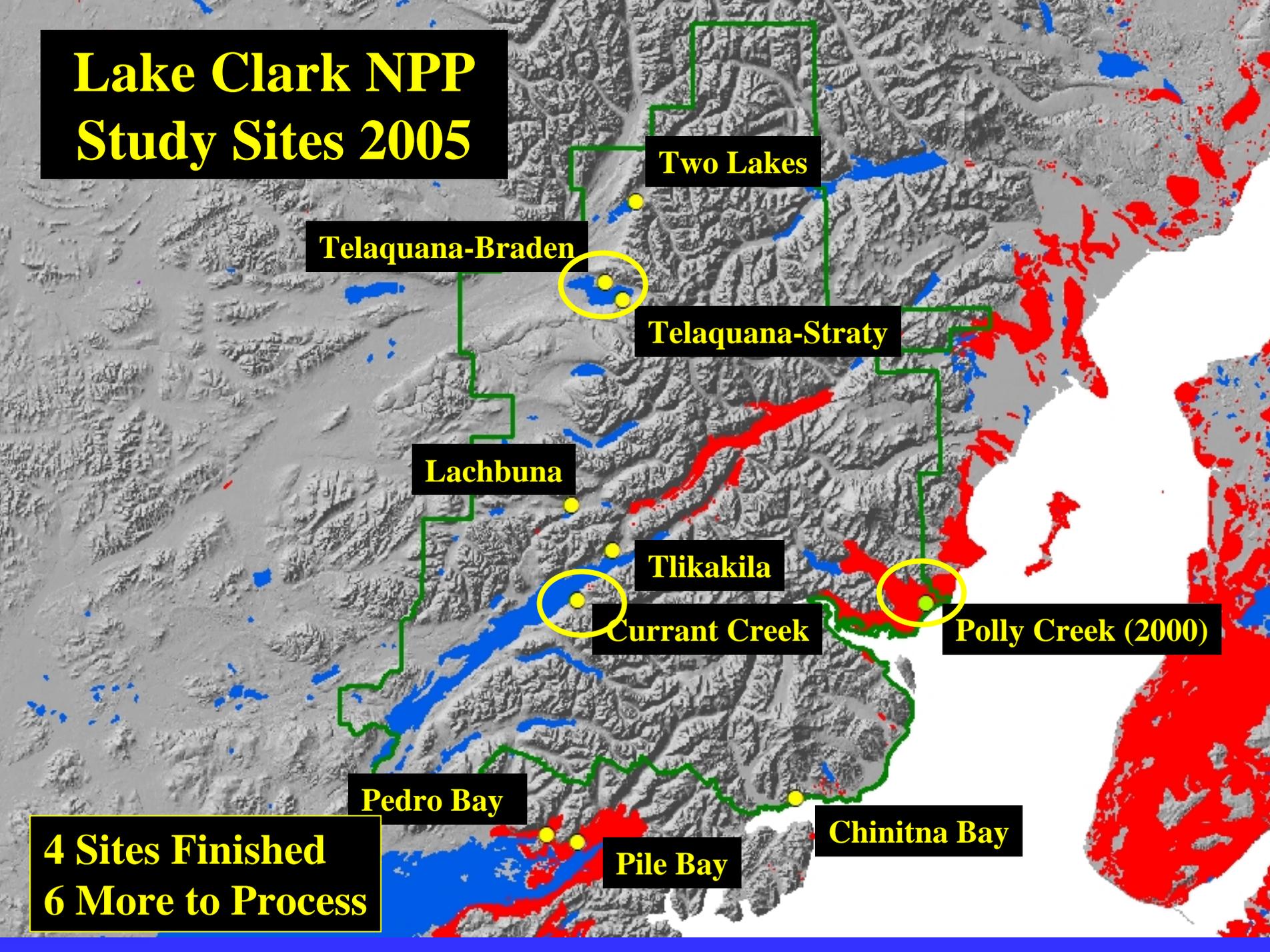
Polly Creek (2000)

Pedro Bay

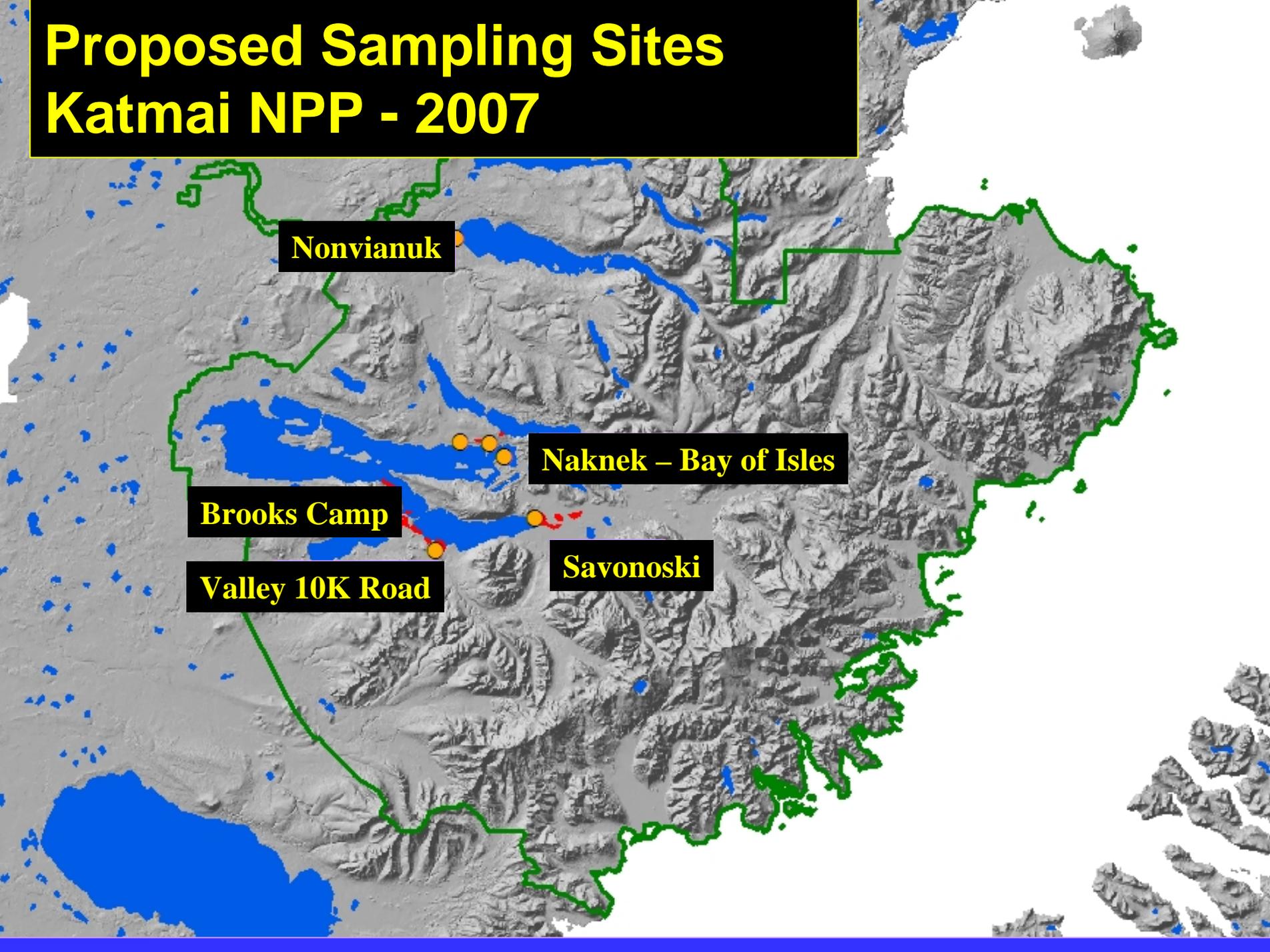
Pile Bay

Chinitna Bay

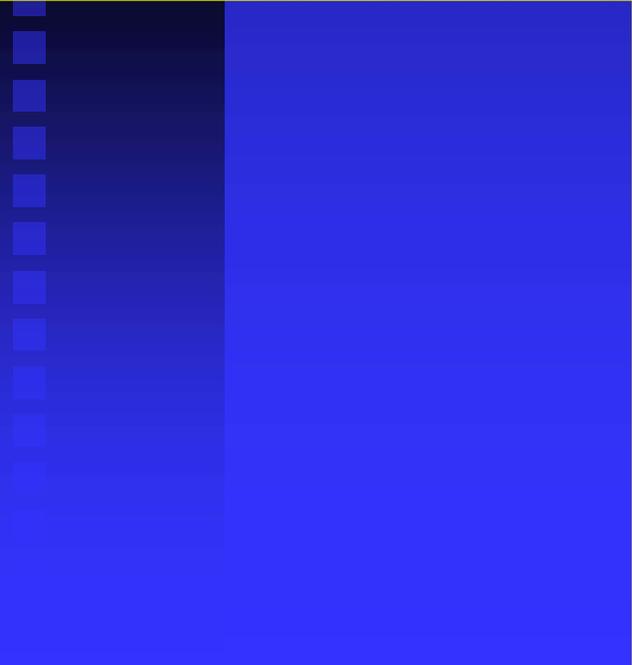
4 Sites Finished  
6 More to Process



# Proposed Sampling Sites Katmai NPP - 2007



# Naknek Lake Beetle Kill



# Preliminary Conclusions

- The three interior Lake Clark NPP sites examined show evidence of low-level thinning events during the 19<sup>th</sup> and 20<sup>th</sup> centuries.
- The coastal Polly Creek site was heavily hit by the beetles in the late 1870 – early 1880s, as was the southern Kenai Peninsula.
- The warm summers of the 1990s triggered beetle outbreaks in stands of mature of slow-growing (stressed) trees.
- Katmai NPP may or may not show a history of bark beetle activity because it is on the edge of white spruce distribution.

# Some Final Photos

# Telaquana Lake – Straty Cabin Area



**Ed Berg and Mat Bowser**



# Spruce Bark Beetle Maternal Gallery



**Bark Beetle Holes -  
Where It All Begins...**

